Available online at: http://ijer.ftk.uinjambi.ac.id/index.php/ijer
IJER, Vol. 9(1), 30-37

Literature Review: 21st Century Skill-Based Learning Model in Junior High School Science Learning

Sri Anika Cahayu[1*], Rayandra Asyhar[2], Bambang Hariyadi[3], Muhammad Haris Effendi[4]

[1,2,3,4] *Jambi University, Jl.Jambi-Ma.Bulian KM 15, Jambi, Indonesia*

Abstract

21st century skills are technology-based learning, characterized by the development of information, computing, automation, and communication. This certainly has an impact on the education applied to how the learning model can meet all the challenges and demands of 21st century skills. The purpose of this study is to review learning models based on Abab 21 skills and evaluate them through an analysis of 4C skill indicators. The research method used in this study was a qualitative descriptive method. The data collection technique used in this study was library research or online literature review from sources such as Google Schoolar, Research Gate, SINTA, and DOAJ. The technique used in collecting articles uses a Publish or Perish (PoP) application with the PRISMA technique, which has stages of identification, screening, eligibility, and inclusion. The results of the study show that 21st century learning models in science learning are flipped classroom, project-based learning (PjBL), problem-based learning (PBL), blended learning model (MBL), and incuiry and discovery learning. The indicators of 4C skills are critical thinking (FRISCO), creative thinking (fluency, flexibility, originality, and elaboration), communication, and collaboration (respect, willingness, and compromise). The application of these learning models must be carried out optimally in accordance with the indicators used to develop 21st century skills in students.

Keywords: *21st century skills, Learning model, Science learning*

1. Introduction

21st Century Learning is a learning that is marked by the great development of technology. The rapid development of technology has greatly affected all fields, including education. In the field of education, the influence of technology lies in the learning process known as 21st century learning. The concept of education in the 21st century is very important to develop because judging from the increasingly tight competition map of the world of work, it is not enough if students are only equipped with cognitive abilities. 21st century skills are competencies that prepare the 21st century generation for the advancement of Information and Communication Technology (ICT), which has a rapid influence on learning activities. The influence of ICT on learning requires students and teachers to master technology so that they have skills in its use (Ariyanto et al., 2020) (Yulianti & Wulandari, 2021). 21st century skills are known as the 4C term consisting of critical thinking, creative thinking, communication, and collaborative (collaboration) that students must have in order to be able to face future challenges (Redhana, 2019).

Based on 2016 Permendikbud, Trilling & Fadel (2012) stated that the learning approach in science subjects in junior high school is a scientific approach consisting of five phases (observing, questioning, collecting data, associating data, and communicating). However, science learning needs to be supplemented with an approach that adjusts to the demands of 21st Century skills where students are required to have 4C skills, namely critical thinking, creativity, collaboration, and communication. The existence of this adjustment will certainly affect the format of the learning tool, the demands of the learning model, and the learning approach that can adapt to 21st century skills.

According to all types of subjects, the development of 21st century skill abilities, especially science subjects. Studying science is not only learning in the form of declarative knowledge in the form of facts, concepts, principles, and laws, but also learning about procedural knowledge about how to obtain information, how science (science) and technology work, and science work habits (science) can improve the ability to think critically, logically, and solve problems creatively. Science learning cannot be separated from students' experiences in daily

*) Corresponding Author
E-mail: anikacahayus@gmail.com

life; therefore, science learning should pay attention to the teacher's ability and the skills needed to provide learning experiences to students so that meaningful learning outcomes can be achieved. This is in line with the opinion that the process of learning activities in the 21st century is designed so that learning activities are student-centered and Makhrus (2018) and Rafianti (2018) teachers are no longer the center of learning, but as facilitators. This shows that 21st century learning activities are based on the real world, authentic through projects and questions, inquiries, discoveries, and inventions in the practice of knowledge.

Based on the above view, to achieve learning outcomes in accordance with expectations in 21st century learning, it is inseparable from the role of a teacher. Efforts that can be made by teachers are to apply methods and 21st century-based learning models that are able to create an effective learning atmosphere in the classroom. This is in accordance with the applicable curriculum in Indonesia, where students are directed to carry out scientific learning so that they can develop critical thinking and problem-solving skills, creativity and innovation, collaboration, and communication according to 21st century skills. Teachers and educators are expected to be able to use the best learning model according to the child's condition, learning environment, and carrying capacity. With this learning model, teachers can conduct assessments with 21st century skill assessments.

The purpose of this study is to review learning models based on Abab 21 skills and analyze them using an analysis of 4C skill indicators. By understanding the learning models applied in the 21st century, it is hoped that the learning process and competency of the 21st century can be achieved.

2. Method

The research method used in this study was a qualitative descriptive method. The data collection technique used in this study was library *research* or literature review, which is a literature search from various reference sources with the same topic so that a certain topic is produced. (Marzali, 2016)

Researchers have limited the time span of article publication from 2018 to 2023. The articles used in this study were obtained from sources such as *Google Scholar*, *Research Gate*, SINTA, and DOAJ. The technique used in collecting articles uses a Publish or Perish (PoP) application with the PRISMA technique, which has stages of *identification*, *screening*, *eligibility*, and *inclusion*. At the identification stage, researchers found 62 articles using the keyword "21st century skills learning model". The 62 articles were then fed into VOSviewer software to examine the relationship between the topic of the 21st century skills-based learning model and other topics. The results of the analysis using VOSviewer are shown in **Figure 1.** After passing the screening stage by checking variables that were in accordance with the RQ and *eligibility* that validated the feasibility of the article to be analyzed, six articles were included in the category included in this study. We then analyzed several related articles. Furthermore, we draw conclusions and evaluate previous research on 21st century skill-based learning models suitable for application to science learning.

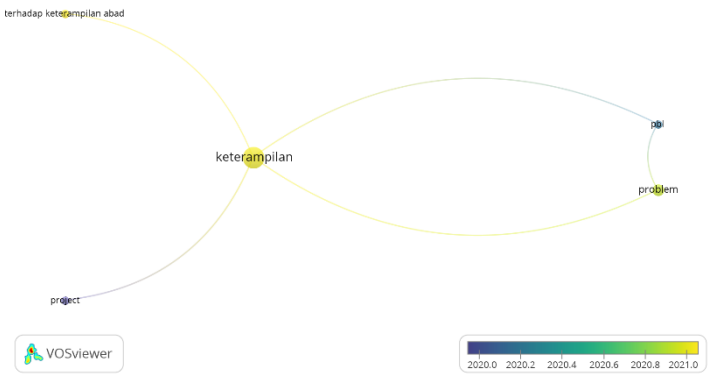

Figure 1. Bibliometric 21st Century Learning and Skills Model Relationship Map

The two topics connected in figure 1 with curved lines indicate the relationship between them. Topics that are not connected by curved lines indicate that they are unrelated to each other. Each cluster contains related topics, such as learning models, 21st century skills, projects, problems, and PBL. Using *VOSviewer*, research trends related to 21st century learning and skills models can also be seen in Figure 1, where the curved lines and circles in yellow indicate the trend of novelty research.

3. Results and Discussion

Based on the search results, the article uses *a publish or perish* (PoP) application with the keyword 21st century skill learning model accredited by Sinta. The results show six articles that are relevant to describing the study of 21st century skill-based learning models as an important aspect of learning, as described in **Table 1**.

Table 1. Analysis of 21st Century Skill-Based Learning Models

It	Article Title	Research Methods	Results / Findings of the Review
1	Application of *the* 21st Century Learning-based Project Based Learning Learning Model in Improving Students' Writing Skills in Gowa Regency (Nurhaedah et al., 2019)	Classroom Action (PTK)	*Project Based Learning* is a learning model that uses projects or activities as a medium, where students will explore, assess, interpret, and inform to produce various forms of learning outcomes. Based on the results of the research with the application of the 21st century-based PjBL model is effective in improving students' writing skills in Gowa Regency, it is proven that the average score of student learning outcomes in the first cycle is 60.8% and there is an increase in the second cycle with an average score of 100% student learning outcomes. The enthusiasm and creativity of students in participating in the teaching and learning process is increasing. These findings show that *the Project Based Learning* (PjBL) model can be used as an alternative to the 21st century skill-based learning model so that it improves one of the students' skills as well as enthusiasm and students become more creative.
2	Improving Students' Ability to Think Critically Through *the Problem Based Learning* (PBL) Model (Minarti et al., 2023)	Literature review	The *Problem Based Learning* (PBL) model is a learning method that utilizes problems as a first step in gathering and integrating new knowledge. Based on the results of a literature review of 15 articles, the *Problem Based Learning* (PBL) model is able to improve students' critical thinking skills. With the application of problem-based *learning*, critical thinking skills can develop, because the critical thinking skills observed in this study are in the form of the ability to identify, analyze, solve problems, think logically and make decisions appropriately and be able to draw conclusions. The results of this finding show that the existence of a problem-based model in the form of *a problem-based learning* model can improve one of the 21st century 4C skills, namely *critical* thinking, without this learning model greatly affects students' skills in making a decision on a problem in learning.
3	*Flipped Classroom* : A Learning Model to Achieve 21st Century Skills According to the 2013 Curriculum (Yulianti & Wulandari, 2021)	Qualitative descriptive	*Flipped classroom* is a learning model where students learn material at home through videos or online then when in class, students will do assignments. The flipped classroom model is a learning activity that involves many students and teachers only as facilitators. So that learning is student-centered. In addition, the activities of observing, questioning, blunting information, associating and analyzing, and communicating can be implemented in flipped classroom learning. The results of these findings show that the flipped classroom model is proven to improve student learning outcomes. In addition to learning outcomes, *flipped classrooms* can also improve critical

It	Article Title	Research Methods	Results / Findings of the Review
			thinking skills (*critical thingking*), and communication skills (*communication*) so that this model can be used as one of the ways for students to have 21st century skills.
4	Improving Collaboration Skills through *Education for Sustainable* Development-Based *Guided Inquiry Model* on Biotic and Abiotic Materials (Rodliyah & Fadly, 2023)	Kuantitatif *True Experimental*	The Guided Inquiry *model* is a learning model that emphasizes the development of cognitive, affective, and psychomotor aspects in a balanced manner so that learning becomes more meaningful and students are able to find material concepts that are learned independently or in groups with multidirectional discussions. The results of this study show that the use of the *Guided Inquiry* learning *model* based on *Education for Sustainable Development* is more effective in improving collaboration skills. The communication indicator is the indicator that has the highest n-gain score compared to other collaboration indicators of 72.4 in the effective category. These findings show that the 4C skills of the *collaboration* section can be achieved by applying a learning model in the form of *a Guided Inquiry* model to students.
5	Application of *Project Based Learning Model* to Improve Junior High School Students' Creative Thinking Skills: A Systematic Review (Lestari & Ilhami, 2022)	Systematic Literature Review	Based on the literature review of 28 articles, it can be concluded that the methods used in the research are quasi-experimental as much as 61%, PTK as much as 18%, pre-experiment as much as 18%, and qualitative escriptive as much as 3%. Science learning with the PjBl model can improve students' creative thinking ability by 68%, science communication skills by 11%, learning outcomes by 11%, self-efficacy by 7%, and students' mastery of concepts by 7%. The results of these findings show that the use of the PjBL model in science learning can improve 4C (*Critical Thinking, Communication, Collaboration and Creativity*) skills.
6	The Effectiveness of Blended Learning Based on the Schoology-Assisted Stem Education Approach to Improve Critical Thinking Skills in Dynamic Fluid Materials (Ardianti et al., 2019)	Quasi experiment	The *blended learning* model is a *learning activity* that combines face-to-face learning activities with online learning activities. The results of this study show that *the blended learning* model is effective in improving *students' Critical Thinking Skills*. This is shown by the results of the data output in the Independent Sample t-test section, obtained a Sig.(2-tailed) value of 0.00<0.05 which means that it can be concluded that there is a difference in the level of critical thinking skills between the experimental and control classes. Where the control class uses a blended learning *model* and the control class uses a conventional model. These findings show that among the learning models based on improving competencies or skills in the 21st century, including *the blended learning model.*

Based on the results of the literature study, six articles were identified, and the author discusses the variables of the 21st century learning model and skills after going through the stages of PRISMA.

Nugroho (2019) found that *the project-based learning* (PjBL) model can improve students' creative thinking and communication skills in learning environmental pollution materials. This is also supported by the fact that the PjBL

model can improve the 4Cs (Lestari & Ilhami (2022) *Critical Thinking, Communication, Collaboration and Creativity and innovation*) in science learning focused on the sub-fields of biology and chemistry, in addition to that it can also improve learning outcomes, self-efficacy, science communication, and concept understanding. This is evidenced from the results of the review of science learning research with the PjBl model that can improve students' creative thinking skills by 68% and science communication skills by 11%, and it can be concluded that the PjBL model is used as an alternative 21st century skill-based learning model to improve students' creative thinking and communication skills in science learning.

Problem-based learning *models* can help students develop their problem-solving skills (Wahyudiana et al. (2021) ; Reski (2019) . Previous research by Adhitya and Fauziah (2023) examined *the problem-based learning* model on students' critical thinking ability when learning science materials about the human digestive system. The results of the study show that the application of *the problem-based learning* model increases students' critical thinking skills in high-category human digestive system materials, so it is concluded that *the problem-based learning* model can improve students' critical thinking skills. This is also supported by Al-Fikry (2018), who found that *problem-based learning* is effective in improving students' critical thinking skills, as evidenced by the increase in the results of students' posttest after the implementation of the PBL model obtained pre-test (44.32%), post-test (92.32%), and N-gain (86.59%). In research on heat materials using the PBL model. This value shows that the PBL model is quite effective in increasing students' learning of KBK using caloric materials in science learning. From these studies, it can be concluded that among the 21st century skill competencies known as 4Cs, the *problem-based learning* (PBL) model can increase these competencies in students' *critical thinking skills.*

Some studies have combined *flipped classrooms* with various approaches, methods, and learning models (Munir et al.,2018). The results of the study Chiang, (2017) show that *flipped classroom learning* combined with problem-solving strategies is more effective. The successful implementation of *the flipped classroom* causes students to achieve maximum learning outcomes so that they have 21st century skills. This is in accordance with the study results showing that students' cognitive learning outcomes improved after applying Agustiningrum and Haryono's (2017) *flipped classroom* diffusion model and *course review horay.* The use of *the flipped classroom* model causes an increase in classroom activity, which is characterized by most students actively expressing their opinions during class discussions. This is also supported by research showing that implementing flipped classrooms causes creative thinking and communication skills to be higher than other skills. Foster & Stagl (2018)

The Guided Inquiry learning model in learning can improve 21st century skills, namely students' communication and collaboration skills. This is supported by research showing that the Guided Inquiry learning model can also improve students' critical thinking and collaboration skills based on the results of the hypothesis test less than 0.05, indicating that the implementation of *the Guided Inquiry* model has a positive influence on improving collaboration skills (Rodliyah and Fadly, 2023) ; Sarifah and Nurita (2023). Thus, from this research, *the Guided Inquiry* model can be used as an alternative learning model based on improving 21st century skills.

The learning model based on a literature review that is able to master the competencies of the next 21st century is *the blanded learning* model, a learning model which combines face-to-face and online learning using technology (Rahayu et al., 2022). Based on the research, the results of his research on the effectiveness of Putra & Fitrayati (2021) *the blended learning* learning model to improve students' critical thinking skills obtained from the *pre test* and *post test* have differences in the form of an increase in individual scores and the average in critical thinking skills with *the blended learning model*.This is in line with Sutanti (2021) the fact that the blended learning *model* can improve critical thinking skills as evidenced by the average results of the Pretest of critical thinking skills in students of class 5 A without the blanded learning model which is 64.33 lower than that of class 5 B with the application of the blanded learning model, which is 86.25 The average result of the posttest of critical thinking skills in students. This shows that the application of the blanded learning model has an influence on improving the critical thinking ability of 21st century skill students.

Some of the studies described above show that 21st century learning models in science learning are in the form of project-based models and technological pedagogical content knowledge (TPACK) consisting of *project-based learning* (PjBL), *problem-based learning* (PBL), *flipped classroom, incuiry* model, and *Blended Learning* as follows:

Model *Project Based Learning* (PjBL)

The project-based learning model is a learning model referring to the philosophy of constructivism. Projects carried out by students intensify their activities by applying their knowledge and skills. This project-based learning model focuses more on concepts that involve students in problem-solving activities and provides opportunities for students to work autonomously (Liu and Hsiao, 2002; Doppelt, 2005) . The steps of the project-based learning model include: (1) asking basic questions, (2) designing project planning, (3) compiling a

schedule, (4) monitoring students and project progress, (5) testing results, and (6) evaluating experiences. (Redhana, 2019)

Model *Problem Based Learning* (PBL)

Problem-based learning is a curriculum model that uses problems. Some of the issues related to the problem are (1) related to the real world, (2) complex and ill-structured, (3) open-ended, (4) spurring teamwork, and (5) developing previous experiences. There are five main stages in the problem-based learning model: (1) student orientation to the problem; (2) organizing students to learn; (3) guiding individual and group investigations; (4) developing, presenting, and exhibiting works (artifacts); and (5) analyzing and evaluating the problem-solving process. In the era of the Independent Curriculum, the PBL learning model is very relevant and important. (Minarti et al., 2023)

Model *Flipped classroom*

Flipped classroom, known as flipped classroom. The *flipped classroom* is applied by reversing learning activities carried out at school to be carried out at home and vice versa. The flipped classroom learning model changes traditional learning from the initial routine of teachers providing material in the classroom and then changing it to give assignments to be done in the classroom and outside the classroom. In addition, the flipped classroom in learning activities is more student-centered so that students can develop 4C skills. (Rindaningsih, 2018)

The steps of flipped classroom learning are as follows: Yulianti & Wulandari (2021)

a. Before the classroom, students were asked to watch learning videos or other media at home as preparation before participating in the learning activities in class (preclass).
b. Students come to the classroom to carry out learning activities by completing assignments related to the teaching materials that have been studied previously.
c. After the classroom, the last activity was to measure students' understanding of the material that had been taught.

Inquiry-Based Model

The discovery-learning model is a learning model with a scientific approach. The stages of discovery learning are (1) stimulation, (2) problem statement, (3) data collection, (4) data processing, (5) verification, and (5) generalization. (Ramdhani et al., 2017) *Inquiry* is a concept of teaching and learning activities that are student-centered by providing a free space for students to formulate and explore answers to questions asked by students. There are three inquiry, namely *Guided Inquiry*, *Modified Free Inquiry*, and *Open Inquiry* (Rodliyah & Fadly, 2023).

***Blended Learning* Model**

The characteristics of the *blended learning* model are as follows: 1) learning combines various ways of delivery, educational models, learning styles, and various technology-based media; 2) a combination of face-to-face education, independent learning, and online independent learning; 3) learning that is supported by an effective combination of delivery methods, teaching methods, and learning styles; and 4) educators and parents of students have equally important roles as educators, facilitators, and parents as supporters.(Effendi & Wahidy, 2019)

21st Century Skills

21st century skills are important to master to face challenges, problems, life, and career in the 21st century. *The National Education Association* has identified 21st century skills as "The 4Cs." In Table 2.

Table 2. 21st Century Skills

Skills	Definition
Critical thinking Critical thinkingS	Skills to conduct various analyses, assessments, evaluations, reconstructions, decision-making that lead to rational and logical actions.
Creativity thinking Creative Thinking	The skill of discovering new things that didn't exist before, is original, develops a variety of new solutions to each problem, and involves the ability to generate new, varied, and unique ideas.
Communication Communication	Skills to express new thoughts, ideas, knowledge, or information, both in writing and orally.
Collaborative Collaboration	The skills of working together effectively and showing respect to diverse team members, training fluency and willpower in making the decisions necessary to achieve common goals.

Source: (Redhana, 2019)

According to *the Assessment and Teaching of 21st Century Skills* (ATC21S), 21st century skills are organized into four categories, as shown in Table 3.

Table 3. 21st century skills ATC21S

Category	Skills

Ways of thinking	Creativity and innovation, critical thinking, problem-solving, decision-making, and learning about learning (metacognition).
Ways of working	Communication, collaboration, and teamwork skills.
Tools of working	Information literacy and literacy ICT
Living in the world	Citizenship Life and career, personal responsibility and social

Source: (Zubaidah, 2018)

4. Conclusion

In the 21st century, education is becoming increasingly important to ensure that students have learning and innovation skills, skills in using technology and information media, and the ability to work and survive by using life *skills*. The 21st century demands education to prepare students to face global economic competition. *The Partnership for 21st Century Skills* emphasizes that 21st century learning must teach four competencies: *critical thinking, creative thinking, communication, and collaboration.* From the literacy of 21st century learning, it can be concluded that there are several models that can support 21st century skills in science learning, including *project-based learning* (PjBL), problem-based *learning* (PBL), *flipped classrooms, inquiry models*, and *Blended Learning.*

References

Adhitya, R. S., & Fauziah, A. N. M. (2023). Application of the Problem Based Learning Model to Students' Critical Thinking Skills on Human Digestive System Material. *Pensa E-Journal: Science Education*, *11*(1), 38–45. https://jurnalmahasiswa.unesa.ac.id/index.php/pensa/index

Agustiningrum, A., & Haryono, A. (2017). Application of Flipped Classroom Learning Model and Course Review Horay Based on Lesson Study to Improve Student Activities and Learning Outcomes in Economics Subject in Class XI IPS 2 MAN Batu City. *Journal of Economic Education*, *10*(2), 111–120.

Al-Fikry, I., Yusrizal, Y., & Syukri, M. (2018). The Effect of Problem Based Learning Model on Students' Critical Thinking Ability on Heat Material. *Indonesian Journal of Science Education*, *6*(1), 17–23. https://doi.org/10.24815/jpsi.v6i1.10776

Ardianti, S., Sulisworo, D., & Pramudya, Y. (2019). The effectiveness of blended learning is based on the Schoology-assisted Stem Education approach to improve critical thinking skills in dynamic fluid materials. *Proceedings of the National Seminar on Education KALUNI*, *2*, 240–246. https://doi.org/10.30998/prokaluni.v2i0.67

Ariyanto, S. R., Lestari, I. W. P., Hasanah, S. U., Rahmah, L., & Purwanto, D. V. (2020). Problem Based Learning and Argumentation as a Solution in Improving the Critical Thinking Ability of Vocational School Students. *Journal of Education: Journal of Research Results and Literature Review in the Field of Education, Teaching and Learning*, *6*(2), 197–205. https://doi.org/10.33394/jk.v6i2.2522

Chiang, T. H. C. (2017). Analysis of learning behavior in a flipped programing classroom adopting problem-solving strategies. *Interactive Learning Environments*, *25*(2), 189–202.

Doppelt, Y. (2005). Assessment of Project-Based Learning in a Mechatronics Context. *Journal of Technology Education*, *16*(2), 7–24.

Effendi, D., & Wahidy, A. (2019). The Utilization of Technology in the Learning Process Towards 21st Century Learning. *Proceedings of the National Seminar on Education for Postgraduate Programs of PGRI University of Palembang*, 125–129.

Foster, G., & Stagl, S. (2018). How effective is the Inverted Classroom Model (ICM), a teaching tool most SC. *Journal of Cleaner Production*. https://doi.org/10.1016/j.jclepro.2018.02.177

Lestari, I., & Ilhami, A. (2022). Application of Project Based Learning Model to Improve Junior High School Students' Creative Thinking Skills: Systematic Review. *LENSA (Science Lantern): Journal of Science Education*, *12*(2), 135–144. https://doi.org/10.24929/lensa.v12i2.238

Liu, M., & Hsiao, Y.-P. (2002). Middle School Students as Multimedia Designers: A Project-based Learning Approach. *Journal of Interactive Learning Research*, *13*(4), 311–317.

Makhrus, M., Harjono, A., Syukur, A., Bahri, S., & Muntari. (2018). Identification of Teachers' LKPD Readiness for 21st Century Skills in Junior High School Science Learning. *Scientific Journal of Educational* Professions, *3*(2), 124–128.

Marzali, A. (2016). Writing a Literature Review. *Journal of Ethnosia*, *1*(2), 27–36.

Minarti, I. B., Nurwahyunani, A., & Bashoriyah, R. (2023). Improving students' ability to think critically through the Problem Based Learning (PBL) model. *ENTINAS: Journal of Education and Learning Technology*, *1*(2), 388–393.

Munir, M. T., Baroutian, S., Young, B. R., & Carter, S. (2018). Flipped classroom with cooperative learning as a cornerstone. *Education for Chemical*

Engineers, 1–9. https://doi.org/10.1016/j.ece.2018.05.001

Nugroho, T. A., Jalmo, T., & Surbakti, A. (2019). The Effect of the Project Based Learning (PjBL) Model on Communication Skills and Creative Thinking. *Journal of Bioteredudik*, *7*(3), 50–58.

Nurhaedah, N., Supriadi, S., & Satriani, S. (2019). The application of the 21st Century Learning-Based Project Based Learning Learning Model in Improving Students' Writing Skills in Gowa Regency. *Algazali International Journal Of Educational Research*, *2*(1), 65–74.

Putra, H. A. D., & Fitrayati, D. (2021). The effectiveness of the blended learning model to improve students' critical thinking skills in economics lessons. *Educational : Journal of Educational Sciences*, *3*(4), 1765–1774. https://doi.org/10.31004/edukatif.v3i4.676

Rafianti, I., Anriani, N., & Iskandar, K. (2018). Development of Mathematics Learning Tools in Supporting 21st Century Abilities. *Journal of Mathematics Education*, *3*(1), 123–138.

Rahayu, R., Iskandar, S., & Abidin, Y. (2022). 21st Century Learning Innovation and Its Application in Indonesia. *Journal of Basicedu*, *6*(2), 2099–2104. https://doi.org/10.31004/basicedu.v6i2.2082

Ramdhani, M. R., Usodo, B., & Subanti, S. (2017). Discovery Learning with Scientific Approach on Geometry. *International Conference on Mathematics and Science Education (ICMScE)*, *895*(1), 1–6. https://doi.org/10.1088/1742-6596/895/1/012033

Redhana, I. W. (2019). Developing 21st Century Skills in Chemistry Learning. *Journal of Innovation in Chemistry Education*, *13*(1), 2239–2253.

Reski, R., Hutapea, N., & Saragih, S. (2019). The Role of the Problem Based Learning (PBL) Model on Mathematical Problem-Solving Ability and Student Learning Independence. *Juring: Journal for Research in Mathematics Learning*, *2*(1), 049–057.

Rindaningsih, I. (2018). The Effectiveness of the Flipped Classroom Model in the Learning Planning Course of the S1 PGMI UMSIDA Study Program. *Proceedings of The ICECRS*, *1*(3), 51–60. https://doi.org/10.21070/picecrs.v1i3.1380

Rodliyah, U., & Fadly, W. (2023). Improving Collaboration Capabilities through the Education for Sustainable Development-Based Guided Inquiry Model on Biotic and Abiotic Materials. *Journal of Indonesian Science Statistics*, *3*(2), 169–179. http://ejournal.iainponorogo.ac.id/index.php/jtii

Sarifah, F., & Nurita, T. (2023). Implementation of the Guided Inquiry Learning Model to Improve Students' Critical Thinking and Collaboration Skills. *Pensa E-Journal: Science Education*, *11*(1), 22–31. https://ejournal.unesa.ac.id/index.php/pensa

Sutanti, Y. A., Suryani, S., & Supardi, Z. A. I. (2021). Implementation of Blended Learning-Based Learning Model to Improve Critical Thinking Skills and Learning Outcomes of Elementary School Students. *Journal of Educational Sciences*, *4*(3), 594–606. http://jayapanguspress.penerbit.org/index.php/cetta

Trilling, B., & Fadel, C. (2012). *Partnership for 21st Century Skills* (1st ed.). Jossey Bass.

Wahyudiana, E., Sagita, J., Iasha, V., Setiantini, A., & Setiarini, A. (2021). Problem-Based Learning-Based Science Practicum Module to Improve Problem-Solving Skills. *Buana Pendidikan 17*(2), 161–167. http://jurnal.unipasby.ac.id/index.php/jurnal_buana_pendidikan/index

Yulianti, Y. A., & Wulandari, D. (2021). Flipped Classroom: A Learning Model to Achieve 21st Century Skills According to the 2013 Curriculum. *Journal of Education: Journal of Research Results and Literature Review in the Field of Education, Teaching and Learning*, *7*(2), 372–384. https://doi.org/10.33394/jk.v7i2.3209

Zubaidah, S. (2018). 21st Century Skills: How to Learn and Solve It. Delivered at the *National Seminar* with the theme "Challenges of Biology and Biology Education in the 21st Century" at Biology Education FKIP Islamic University of Riau, April 28, 2018